THE BRITISH SOLAR ECLIPSE EXPEDITION.[1]

T.S.S. "Marama,"
Pacific Ocean,
May 20, 1911.

MY last letter was very brief, as the ss. *Bouverie*, the steamer which ran on a coral reef and was subsequently got off, arrived unexpectedly at Vavau on her way to San Francisco. This meant that a mail could be sent by her, but only a short letter was written in consequence.

Although this letter is sent by the following mail to England, it happens that I am travelling in that particular mail steamer which is bound for Vancouver. We have therefore had a considerable time now to consider past events, and, incidentally, I have been down with a sharp attack of fever which I managed to pick up at Fiji; we are now three days off Honolulu, and I am convalescent.

Although during the first ten days of our stay at Vavau the weather conditions were all that could be desired for eclipse work, they gave way slowly to quite a different type; while rain had been the exception, it now became a daily occurrence, and not only did it rain, but it came down in torrents. This change of weather put quite a different complexion on our prospects. Nevertheless we worked and hoped for the best, but still the nearer the eclipse day approached the worse the weather became. On the day before the eclipse my notes regarding the weather are as follows:—"To-day would have been a bad day for the eclipse. There is a great amount of high cirrus which would have prevented good photographs from being secured, and the presence of low drifting cumuli would most probably have totally blotted out the sun for some period during totality. I expect the conditions to-morrow will be somewhat like Palma over again, but I hope the cloudy part will occur at third contact and not at second contact as it did there."

Luck was against us, however. Eclipse morning broke, and this was the cloudiest we have experienced. Cirro cumulus cloud in the form of waves extended over a considerable part of the sky, and low cumuli of various sizes were numerous. There was sufficient sun at intervals for all the instruments to be set and kept running, and I went round all the individual instruments and critically examined the definition of the solar images on the ground-glasses. Everything was most satisfactory.

I had arranged that all the working parties should be ashore at 7 a.m., and that the remainder should arrive half an hour later. The camp assumed a most business-like air, and everyone seemed glad that the day had at last arrived. I had taken the precaution to distribute parties as far apart as possible that could be distributed, and with this object I sent one party off early in the morning to take up their position on Talau Hill, 400 feet high and about three miles distant. This party consisted of observers for stars, shadow phenomena, and drawing the corona, and a small camera party. On another hill, 200 feet high and half a mile away, a second similarly constituted party was dispatched. A special party was also on board, and men placed at the mastheads.

Alas! with all these precautions no party saw the sun free from clouds. There is little doubt that, as the moon gradually covered the sun and a natural reduction of the air temperature took place, the tremendously moist atmosphere gradually condensed in the form of cloud, which became denser the nearer totality approached. Some minutes before second contact a very large black, dense cumulus with billowy tops came sweeping up from the eastward, and this cloud it was that practically sealed our doom. Onward it came, and just before second contact its outliers began to cover the sun and then totally eclipse it. The presence of the clouds made the image of the cusp very difficult to observe, as it was jumping up and down on the card. The cusp observer had eventually to give the signals from the chronometer alone.

Three whistles, two whistles, and one whistle were the signals to precede the order "go," and at "go" the whole camp began their combined effort. I fired off my first four instantaneous exposures, and then one of a few seconds, and then a long one. During this last I went out of my tent with opera-glasses and card and pencil to draw the corona, when, alas! I could not even see where the sun ought to be. The large ominous black cloud had completely blotted out the whole region. I returned to my tent very sad; at a later long exposure I emerged once more, and there was the silvery corona as rigid as an Indian order suspended in the sky. It was shorn of most of its beauty, for the cirrus cloud was very thick, and must have absorbed a great amount of light. There was no doubt about its form, however, for at a glance it represented the minimum type known as the wind vane.

Something extraordinary, however, seems to have happened. While the timekeeper shouted out twenty, *i.e.*

FIG. 1.—Landing the Instruments.

[1] Continued from p. 529.

FIG. 2.—In the early stages of the erection of the Instruments. View taken from a Cocoanut Tree.

FIG. 3.—A General View of the Eclipse Camp. Camera facing nearly West.

there are twenty seconds left, the sun burst through! The eclipse was over!

Being busy with my instrument at the beginning of totality, and not being able to see the sun because of the roof of my tent, I could not observe whether totality began with the word "go." A consultation with my *confrères* afterwards soon gave me the information I was seeking. The eclipse began fully twelve seconds before the word "go" was given, and finished twenty seconds before the word "stop" was shouted. This very considerable difference between calculation and observation seems at present unexplainable, but similar, or nearly similar, times were recorded by the other parties at Neiafu.

In addition to three chronometers, regular transit observations had been daily made with the transit that was set up on a concrete pillar in our camp. The ship's chronometers were also in very close agreement with those we brought out, so there could be no error of any magnitude regarding the time. This important matter will be cleared up when Mr. Brooks, who has the matter in hand, sends in his report on the subject.

The eclipse being over, I called my party together, and we gave three cheers for the captain, officers, and men of H.M.S. *Encounter* for the magnificent assistance they had rendered on the occasion of this eclipse. It was most disappointing that the weather had been so unfavourable, for had it been otherwise we should have gathered a wonderful harvest of valuable solar data.

While we were so hard dealt with at our station, the Australians at Neiafu, about a mile from us, suffered nearly the same experience. They watched the approach of the large cloud, and thought that it would affect them and not us—it affected both of us, however, with disastrous results. A hundred yards or so distant from the Australian camp was that of Mr. Worthington and his party. He seems to have been wonderfully lucky, for in spite of all the clouds about, a rift in them enabled him to secure some beautiful photographs of the corona, as good as the best photographs that have ever been taken during an eclipse. I have not seen the negatives myself, but everyone who has is most enthusiastic about them.

On development of the photographs of my party, the useful results are very meagre. No record at all was shown on the large films of the large grating spectrograph worked by Mr. McClean. On the 6-inch prismatic camera plates one plate may be very useful. This plate was closed at twenty seconds according to the eclipse clock, *i.e.* was closed about half a second after third contact. All the chromospheric large arcs are well shown, and a great number of short bright arcs, showing that a record of the chromosphere was secured. There is a certain amount of continuous spectrum shown on the plate, but the spectrum is rich in lines in the violet end. A plate exposed immediately after this gives a dark-line spectrum. Several of the coronographs show images of the corona sufficiently good to enable the general form of the corona to be deduced, but they all show too much cloud. The 4-inch 16-foot coronograph has perhaps the best record of the lower corona, and this is beautifully sharp and gives a very fine photograph of the large prominence, the most conspicuous object just before third contact.

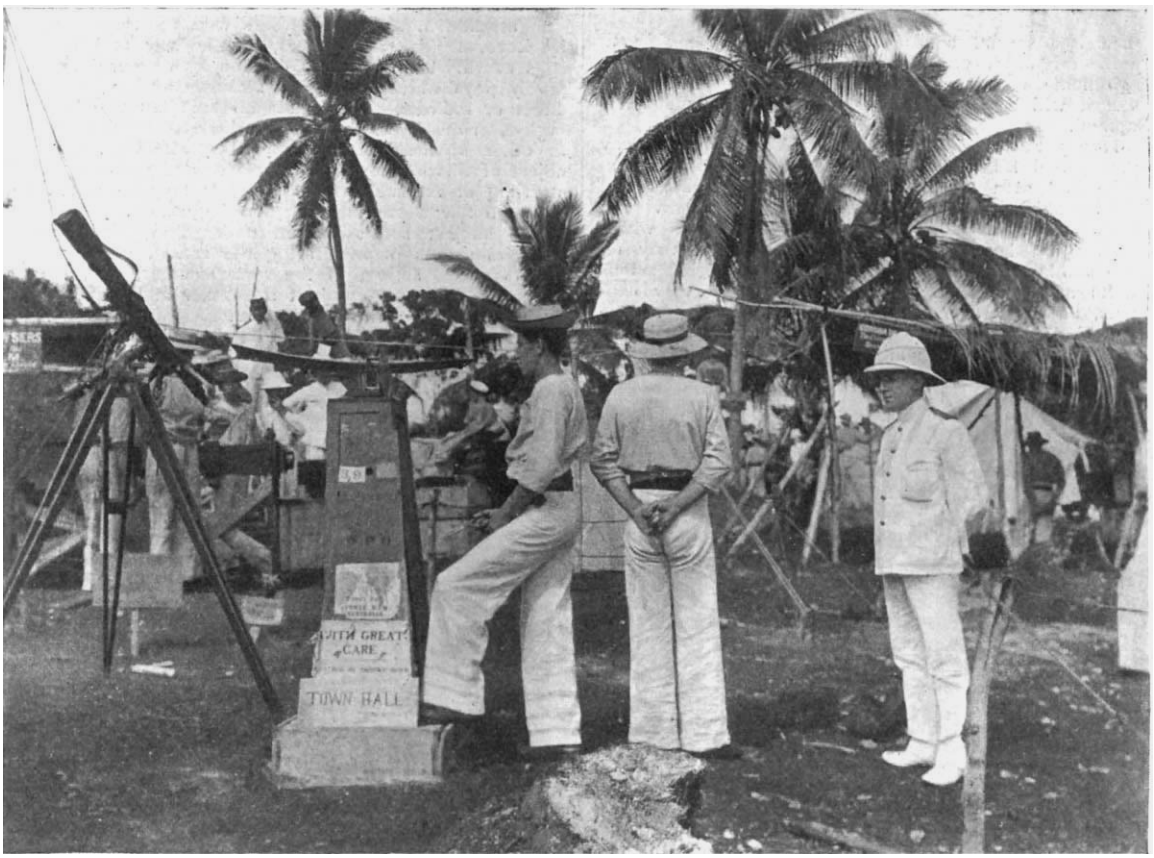

FIG. 4.—The Captain and his two time callers at the Eclipse Clock.

The above practically sums up the results of the expedition from the astronomical side. In other directions we have positive results. Thus a fine series of observations made with the self-recording barograph, thermograph and hydrograph have been secured. A very complete collection of botanical specimens representing the wild flowers, ferns, &c., and numerous seeds, of the island will, I hope, prove useful.

An excellent collection of butterflies and moths representing most of the varieties has been made, and we are bringing home numerous pickled specimens of fish, centi-

pedes, lizards, ants, scorpions, &c. Geological specimens were not numerous, but what there were were secured. A large number of specimens of shells and different varieties of coral were also collected.

The day following eclipse day, a Sunday, it rained steadily from morning until night. The camp became a hopeless morass; every tent was saturated through and through, and most of the contents as well. Fortunately, packing up had been commenced directly totality, of the day before, had finished, and by the evening the greater portion of all the instruments were safely housed away in their packing-cases in the instrument tent. Fortunately, again, I had had the floor of this tent covered with thick rafters to keep the cases off the ground, and if it had not been for this precaution the cases would have been thoroughly soaked. The rain therefore did little damage. We filled as many barrels as we had with the water from the awnings, and this came in extremely useful for the dark-room during the subsequent days spent in developing and making copies.

I had two special boxes made on board the ship to carry the original negatives, and the copies and one box will go home with the rest of the packing-cases, while the second will be dispatched later by a different steamer to England.

On May 3 the ss. *Tofua* arrived at Vavau on her way to Sydney, and I boarded her to inquire from her captain what he had seen of the eclipse. Captain Halford had stopped his ship right on the central line, and they viewed the eclipse in a cloudless sky. Several drawings which were made on board were shown to me, and they all indicate similar appearances, namely, equatorial extensions and rifts at both poles. Shadow bands were very conspicuous, and a great number of stars were logged. The captain kindly had a copy of his observations made for me, as I wished to compare the times of his contacts with those observed by us.

In the evening the *Tofua* left with all the eclipse parties except those going by the *Encounter*.

The next morning the *Encounter* weighed anchor from the spot where she had remained so long. I think we were all very glad to get away. If we had had a successful eclipse we might have severed our connection with a pang of regret. There were no regrets. We had worked hard and been treated very badly, and some of us, myself included, hoped we should never see the spot again. Out of the little harbour we steamed, stealing away before the inhabitants were up. One by one we passed the thickly tree-covered islands, and at last we came to the open sea and the cooler air, leaving the pests of flies and mosquitoes behind us. Oh those flies and mosquitoes; they were the curse of the island!

The *Encounter* being now bound for Suva, Fiji, to coal, and land Mr. McClean and myself, our course was shaped for that island. In order to make all land by daylight, a six hours' stop was indulged in off Late Island. This island is on the western outskirts of the Tonga group, and is nothing but a large volcano. With difficulty a landing was made, and while one party, including myself, started out to climb to the crater, another party went to shoot pigeon and pig. Incidentally, I made a good botanical collection, and gathered numerous specimens of seeds. On our return to the shore the tide had gone down, and the pools in the lava were full of the most beautiful coral fish and snakes, weird in colour and shape, that one could desire. An exciting return to the boats ended quite a successful day's adventure. The next day was spent at sea, and we sighted Suva on Saturday morning (May 6). Being "Accession" Day, the ship was dressed as the anchor was let go.

Mr. McClean, Mr. Anderson and myself took up our quarters at this port to await our ship, the t.s.s. *Marama*, which was to take us to Honolulu. On May 11 H.M.S. *Encounter* steamed gracefully out of the harbour on her way to Sydney, and it was sad to see her go without us, for both officers and men had become quite endeared to us. However, it had to be, and we watched her until nothing more than smoke was visible.

At Suva there was little to be done, as it was very hot, but there were no flies and very few mosquitoes, so we might have been worse off. On May 13 we drove to Rewa, a distance of twelve miles, and then took a motor-boat up the fine river Rewa, the upper reaches of which are very beautiful. To me this trip was disastrous, for next day I was laid up with fever. On May 15 our steamer, the *Marama*, bound for Honolulu and Vancouver, arrived, and we boarded her and sailed the same evening. At the moment of writing (May 21) we are now two days off our destination, and we are indulging in the cool N.E. trades after the stillness of the doldrums.

After Honolulu we are bound for the States, where I hope to see first hand the chief American astronomical observatories. We are due in England about July 11, when we shall have completed a most interesting circuit of the earth. We shall have gained one day!

W. J. S. LOCKYER.

A NEW ROD OF AARON.

THE naturalist and the physiologist have been well acquainted for several years with the results achieved by Loeb, Delage and others, in the way of causing the eggs of various animals to develop by chemical and other purely physical means, apart altogether from the agency, direct or indirect, of the male animal; but these astonishing experiments are still very little known to workers in other sciences. Before directing attention, as is the object of this short note, to the last and perhaps the most startling of all such experiments, it may be worth while to say a few words on the general question.

The subject seems to fall under two heads, namely, artificial means of facilitating the action, or of widening the sphere of action, of the male element, and, secondly, means of dispensing with it altogether and of replacing it by some wholly artificial stimulus.

In Loeb's early experiments he showed that, while under normal conditions the eggs, for instance, of a sea-urchin could not be cross-fertilised by the sperm of a starfish, yet by simply rendering the surrounding sea water faintly alkaline, a new condition was established in which the sea-urchin's eggs were capable of fertilisation by the sperm-cells of any or every species of starfish, and by certain other alien species of echinoderms besides, while, at the same time, in this more alkaline sea water the sperm of the original sea-urchin had actually lost the power of fertilising the eggs of its own species.

More than five-and-twenty years ago it had been shown, by Tichomiroff and others, that the eggs of the silkworm could be caused to develop "parthenogenetically" by simple mechanical stimulation, such as brushing, or by chemical treatment, as with sulphuric acid. But these results attracted less notice than they should have done, partly, perhaps, because in other insects parthenogenesis, or the development of unfertilised eggs, was known to occur under natural conditions, as in the case of green-flies or plant-lice (Aphides), or in the case of the drone-progeny of the queen-bee.

Passing over various intermediate experiments, we come to those which Loeb published in 1904, in which he showed that, if the eggs of a sea-urchin be put into sea water to which has been added a little formic, acetic, butyric, or other fatty acid, and then after a minute or two be put back into ordinary sea water, they begin to show the initial changes characteristic of nuclear division. But if, on the other hand, they be transferred from the acidified sea water to sea water the concentration of which is increased by a suitable addition of common salt, then the whole cycle of development proceeds just as though normal fertilisation had taken place, and the highly complicated free-swimming larvæ are produced in unlimited numbers and in the same manner and at the same rate as in the ordinary course of sexual development; and if the experiment has not been carried further, to the complete post-larval development of the entire sea-urchin, it must be remembered that the artificial feeding and rearing of this and other marine animals beyond a certain stage, even from normal and fertilised eggs, is a matter of the very greatest difficulty. Precisely similar experiments have been successfully performed by various workers on marine worms and molluscs, and a few years ago Bataillon showed that even the eggs of the lamprey could be induced to segment by simply placing them in water of a certain